

TRZ

Ultrasonic Transducer and Horn Analyzer

For testing and tuning power ultrasonic transducers, converters, boosters, horns and stacks.



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TRZ Analyzer is the key instrument for effective manufacturing, quality control and maintenance of power ultrasonic transducers, converters, boosters, horns and acoustic stacks.

How it works

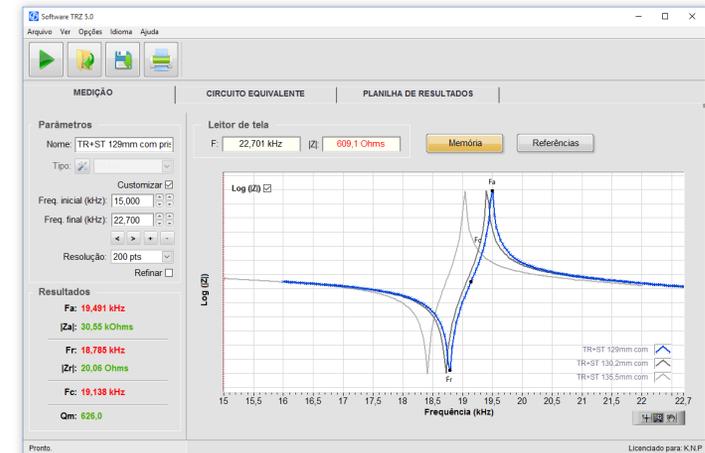
TRZ determines the resonance and antiresonance frequencies and impedances of the device under test by doing a frequency sweep. See the last page for information on how to use these results.



Result of a 20 kHz welding converter test.

Software TRZ

TRZ Analyzer includes the TRZ Software, which makes the tuning process easier, calculates the mechanical quality factor and determines the BVD equivalent circuit. The Software also applies acceptance criteria, generate report and save results.

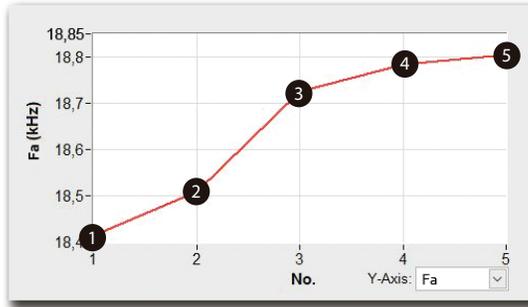
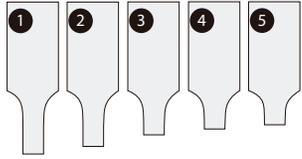


TRZ Software comparing measurements.

The TRZ Analyzer provides:

- High technology with excellent benefit-cost ratio.
- High return on investment with the reduction of maintenance costs.

Follow the tuning process with graphics



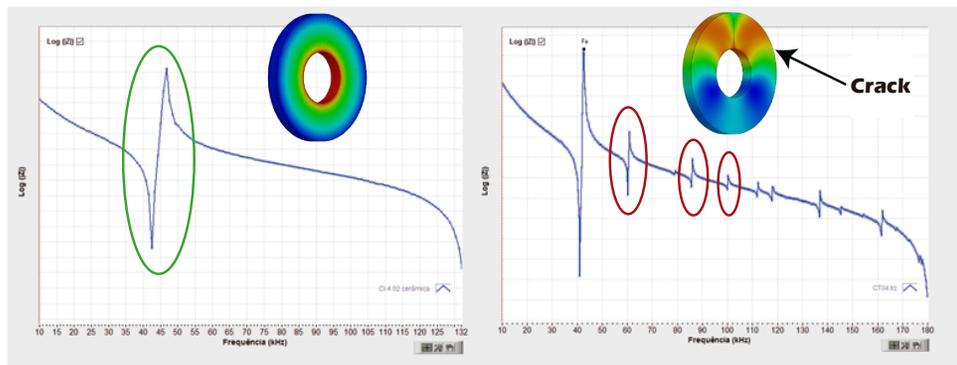
TRZ Software allows the step-by-step monitoring of frequency and other parameters variation along the machining process, as well as a function of time and temperature.

Piezo ceramics testing for cracks detection

By using the “PiezoHolder” accessory, it is possible to test piezoelectric ceramics for internal cracks detection, perform the quality control of new ceramics and reuse recovered ones with reliability.



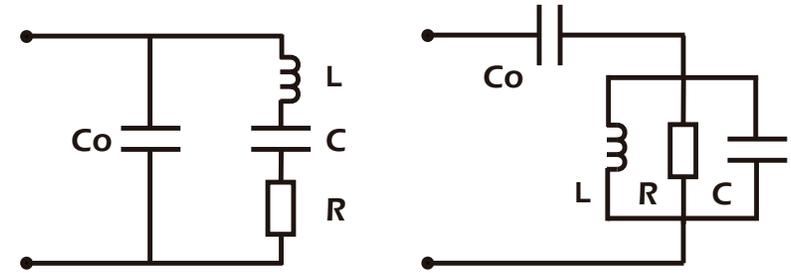
“PiezoHolder”



Measurements showing the pattern of a ceramic with no cracks (left graph) and of one with an internal crack (right graph). The presence of cracks is easily identifiable by additional resonances.

Calculate the equivalent circuit and the quality factor

The TRZ Software is able to calculate the Butterworth-Van Dyke (BVD) series and parallel equivalent circuit of the device under test, and from this equivalent circuit, the quality factor Q .



Series and parallel configurations of the Butterworth-Van Dyke equivalent circuit.

Technical specifications:

Frequency range:	1 - 200 kHz with 1 Hz resolution
Frequency uncertainty:	$\pm 0.05\%$ @ 25 °C
Impedance range:	0.1 Ω – 999.9 k Ω
Impedance uncertainty:	$\pm 3\%$ @ 20 kHz within the range 0.1 Ω - 10 k Ω
Memory:	01 (last measurement)
Dimensions and weight:	26 x 25 x 10 cm / 3.8 kg

The TRZ Analyzer calibration and functional test may be easily performed by using the “TRZ Calibration Kit”. This accessory is especially interesting for critical applications, eg. for the quality control of medical equipment. The “TRZ Calibration Kit” consists of a 10 k Ω precision resistor and a standard 100 kHz resonator.



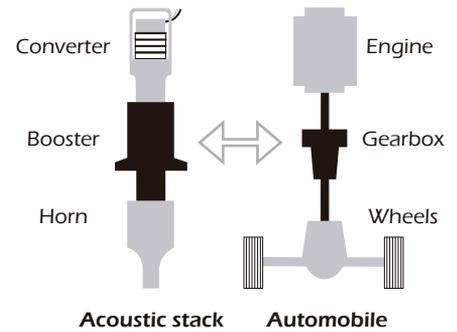
“TRZ Calibration Kit”

Power ultrasonic technology

Power ultrasonic stacks convert electrical energy into vibration. To understand its operation principles we can compare the ultrasonic stack with an automobile [1].

The converter performs the energy conversion as the engine; the transformer adjusts the ratio between force and speed as the gearbox; and finally, the horn directs and applies the energy as the wheels do.

In the automobile, all the mechanical parts must match perfectly each other in order to improve the energy transmission efficiency as much as possible. The same occurs with ultrasonic systems where the key matching parameters are the frequency and parts coupling.

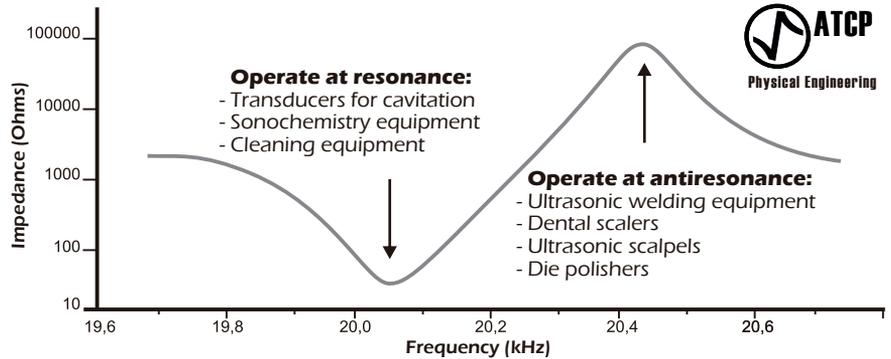


1 Operational modes

Transducers, converters and acoustic stacks have two operating frequencies that are easily identifiable on its electrical impedance curve.

The impedance maximum corresponds to the antiresonance frequency, where the vibration speed and amplitude are maximum. Ultrasonic welding systems usually operate at this frequency.

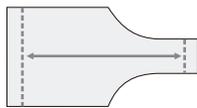
The impedance minimum corresponds to the resonance frequency, where the vibration force is maximum. Ultrasonic cleaning systems usually operate at this frequency.



2 Horn tuning

Ultrasonic horns must be tuned to work properly, avoid overheating and to have a long useful life. The usual tolerance is $\pm 0.25\%$ with regards to the nominal value, for instance, $20,000 \pm 50$ Hz.

To increase the horn frequency:

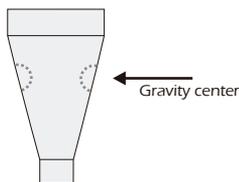


- Reduce the length.

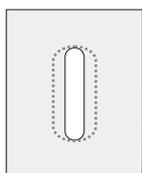
To decrease the horn frequency:



- Advance the radius position,



- Grooves on the gravity center,



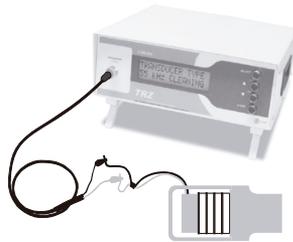
- Widen the slots.

To perform the tuning, use the TRZ Analyzer together with the TRZ Software interleaved with the parts machining.

3 Transducers testing

To work properly, the transducer or converter frequency and impedance must be within the tolerance ranges specified by the manufacturer.

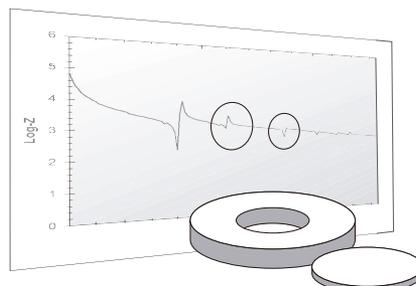
The determinant factors for the transducer frequency and impedance are: dimensions, finishing, compression, ceramics quality and tuning.



5 Piezo ceramics testing

The piezoelectric ceramics are the transducers and converters core and should be tested for internal cracks, even the new ones.

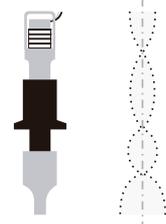
The testing consists of the impedance curve measurement for the detection of anomalous resonances, which indicates the presence of cracks.



4 Acoustic stacks testing

The frequency and impedance of acoustic stacks must be within acceptable ranges. For welding equipment, the typical tolerance is $\pm 0.25\%$ for frequency, for instance, $20,000 \text{ Hz} \pm 50$ Hz.

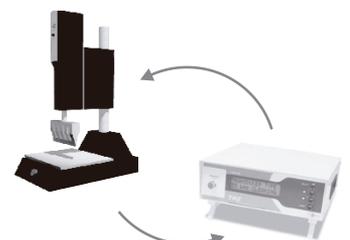
The performance depends on the frequency tuning and the coupling between the stack elements. It may happen that a stack has poor performance, even though operating at the right frequency. That occurs when combining transducers and converters with a symmetrical frequency mismatch (one with low and another with high frequency). This type of problem is detected by measuring the impedance.



6 Preventive maintenance

Source of downtime and loss, faults in ultrasonic welding equipment are reduced by predictive and preventive maintenance.

Frequency deviations indicate wear, and impedance deviations indicates problems of coupling and damaged interfaces. These problems are solved by polishing the interfaces and re-tightening the stack parts.



In addition to preventive maintenance, it is important to also conduct inspections of new and refurbished parts.

[1] Ultrasonic assembly of thermoplastic moldings and semi-finished products - Recommendations on methods, construction and applications. ZVEI (German Electrical Manufacturers Association).